COMMUNICATION

Snowden

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FROM THE

SECRETARY OF THE COMMONWEALTH,

ACCOMPANIED WITH A REPORT OF

JAMES D. HARRIS, ENGINEER,

TO AVOID THE

SCHUYLKILL INCLINED PLANE.

READ IN THE HOUSE OF REPRESENTATIVES, FEBRUARY 21, 1839.

HARRISBURG:
BOAS & COPLAN—PRINTERS.

1839.

COMMUNICATION.

To the Senate and House of Representatives of the Commonwealth of Pennsylvania.

GENTLEMEN:—Herewith are transmitted copies of a communication from the board of canal commissioners, and a report and survey of the engineer appointed to examine and report upon the several routes in contemplation for avoiding the Schuylkill inclined plane, upon the Columbia rail-way, made in pursuance of the seventh section of the act entitled, An act to provide for the repairs and continue the improvements of the state, and for other purposes, passed the 14th of April, 1838.

DAVID R. PORTER.

EXECUTIVE CHAMBER, Feb. 21, 1839.

CANAL COMMISSIONERS OFFICE,
Harrisburg, 20*th February*, 1839.

To his Excellency, DAVID R. PORTER,
Governor of the Commonwealth of Pennsylvania.

SIR:—By the 7th section of the act of the 14th day of April, 1838, entitled an act "to provide for the repairs, and to continue the improvements of the state, and for other purposes," among other duties enjoined on the canal commissioners, they were authorized to cause an examination whether any better mode can be adopted for avoiding the inclined plane at the Schuylkill, on the Columbia and Philadelpia rail-road, than those offered by the Valley rail-road, the West Philadelphia rail-road, and the Chester and Delaware rail-road, and for that purpose were directed to cause a survey to be made by a competent engineer, who had never been employed on either of said roads, of the whole expense of constructing each, reporting the curvatures, grades and distance of each, together with accurate plots or drafts thereof; also, reporting the curvature, grades and distance of the Pennsylvania rail-road from the city of Philadelphia to the bridge at Downingtown, with an accurate plot or draft thereof, showing the points of intersection by said roads; also, reporting the curvatures, grades and distances of the Philadelphia and Wilmington rail road, from the point of intersection to the city of Philadelphia, with an accurate plot or draft of the same; and if after such examination had, the board shall be of opinion that the best interests of the commonwealth and the public convenience would be promoted by the laying out of a new route, or the adoption or purchase of either of the said roads, for the purpose of avoiding the said inclined plane, then to report to the next legislature which of the said routes or roads should be adopted or purchased, and report the result of their inquiries to the next legislature.

In pursuance of the requisitions of the act referred to, I have now the honour of laying before your Excellency, the report of James D. Harris, civil engineer, accompanied with a map and profile of the contemplated survey made under his direction. Without desiring to indicate any opinion at this time in relation to the relative merits of the different routes explored, further than the facts developed by Mr. Harris would seem to warrant, the board deem it no more than their duty to state that they have carefully examined the report herewith submitted, and concur generally in the views and opinions therein expressed.

The present board having so recently entered upon the performance of their duties, they are not prepared from the facts before them, and the information within their reach, at this time, to give any definite opinion upon the subject, further than that already expressed, as would seem by the injunctions of the act of assembly to be their duty. The board are not aware of any negotiations having been entered into by their predecessors with the Valley rail-road, the West Philadelphia rail-road, or the Chester and Delaware rail-road companies for the purpose of ascertaining upon what terms each of said roads can be purchased by the commonwealth. Measures are in progress to procure the desired information, which, as soon as received, will be laid before the legislature. An estimate of the cost of constructing those improvements will be found in the report of the engineer herewith submitted.

I am very respectfully,
Your obedient servant,
JAMES CLARKE,
President board of Canal Commissioners.

REPORT.

To the Board of Canal Commissioners of Pennsylvania.

GENTLEMEN :—The undersigned having been directed by the canal commissioners, to make the surveys required to be made by the seventh section of the act of the fourteenth of April last, entitled "an act to provide for the repairs, and continue the improvements of the state, and for other purposes," has the honor to present the following report:

By the section referred to, "the canal commissioners are authorized to negotiate with the Valley rail-road, the West Philadelphia rail-road. and the Chester and Delaware rail-road company, for the purpose of ascertaining upon what terms each of said roads can be purchased by the commonwealth, and also to cause an examination, whether any better mode can be adopted, to avoid the inclined plane at the Schuylkill, and cause a survey and estimate to be made by a competent engineer who has never been employed on either of said roads, of the whole expense of constructing each, reporting the curvatures, grades and distance of each, together with accurate plots or drafts thereof; also reporting the curvatures, grades and distance of the Pennsylvania rail-road, from the city of Philadelphia to the bridge at Downingtown, with an accurate plot or draft thereof, shewing the point of intersection by said roads; also reporting the curvatures, grades and distance of the Philadelphia and Wilmington rail-road, from the point of intersection, to the city of Philadelphia, with an accurate plot or draft of the same, for which the sum of twelve hundred dollars is hereby appropriated; and if after such examination had, they shall be of the opinion, that the best interests of the commonwealth, and the public convenience would be promoted, by laying out a new route, or the adoption or purchase of either of said roads, for the purpose of avoiding the said inclined plane, then to report to the next legislature which of said routes or roads should be so adopted or purchased, and to report the result of their enquiries to the next legislature."

In accordance with the directions of the canal commissioners, the surveys were begun about the middle of October, and were prosecuted diligently until the seventh of December, when the undersigned having gained possession of all the facts deemed necessary to enable him to report, the field operations were discontinued.

On inquiry it appears to have been the intention of Major Wilson, the engineer who located, and in part constructed the Pennsylvania rail road, to limit the grades upon which motive power was to be used, to 30 feet per mile. The radii of the curves vary from 631 to 3,782 feet, with the exception of one curve at the intersection of Broad and Vine streets, in the city of Philadelphia, which is 294 feet radius.

Mr. Gay, the engineer who subsequently took charge of, and completed the road, having encountered great difficulties in the attempt to reduce the *crest* of the Mine ridge, at the "Gap," to the *maximum* grades, proposed by his predecessor, determined to alter the grade for the distance of two miles, at the summit, so as to stand for *three-fourths* of a mile *on each side of the summit*, 45 feet per mile, and *one-fourth* 40 *feet per mile*. No other material change is known to have been made in the original design.

The grades, for the distance of four miles on each side of the ridge, descend from the ridge at the rate of 30 feet to the mile.

The only curves upon the high grades, (45 and 40 feet per mile,) have each a radius of 1,981 feet.

The precise height of the summit of the ridge at the Gap, above tide water, the undersigned had not the means of ascertaining conveniently, but it is understood to be slightly higher than the ridge to the south of the valley in which Downington is situated. The highest point of the rail road on the Southern ridge, is near the 22d mile post, and about half a mile west of the Green tree inn. This point is 543.5 feet above high tide. The lowest point on the road, in the intervening valley, (which is near the bridge crossing the East Brandywine, west of Downington,) is 249 feet above high tide.

That portion of the rail road between the Green tree Inn and the head of the inclined plane at the Schuylkill, is constructed on or near the top of the dividing ridge, between the streams that fall into the Delaware, and those falling into the Schuylkill. The profile of this part of the road corresponds nearly with the natural surface of the ground, and is considerably undulating. The head of the plane is 233 feet above high tide. The foot of the plane is 46 feet above high tide, and the perpendicular descent at the plane is 187 feet.

The road is slightly undulating between the foot of the plane and the city. The plane of the road at the intersection of Broad and Vine streets, is 42 feet above high tide.

A table of the grades and curves of the road between the city and East Brandywine creek, was published, with the last annual report of the Canal Commissioners, (1837,) having been furnished by William H. Wilson, Esq. engineer. It is not considered necessary to incorporate it with this report, as it can be easily referred to. At points where measurements were made of the degree of grade and curvature, it was found to agree with the table, and there is no reason to doubt its accuracy.

VALLEY RAIL ROAD, AND NORRISTOWN RAIL ROAD.

The survey and examination of the Valley rail road was begun at its western extremity, (two chains east of the 32d mile post, on th

State rail road) near Downington, and was continued to its intersection with the Philadelphia and Reading rail road, on the west side of the Schuylkill near the Conshohocken.

The plane of the Valley rail road was found to be 31.60 feet higher than the Philadelphia and Reading rail road, at the point of intersection, it being the design of the Valley rail road company, to form a connexion with the Norristown rail road, on the east side of the Schuylkill, by means of a bridge and by a descending grade of about 1½ miles in length below the bridge. The highest point on the Valley rail road, between the State rail road and the Schuylkill, was found to be 348.69 feet above high tide, and 194.81 feet lower than the highest point on the State rail road, between Downington and Philadelphia.

The length of the Valley rail road from the State rail road to the Schuylkill is 20 miles and 4 chains. The length of the bridge to be built over the Schuylkill is estimated at 1,320 feet, or 20 chains, making 20 miles and 24 chains in all.

The distance by the Norristown rail road from the eastern end of the bridge, to the *depot* at the intersection of Ninth and Green streets, is 13 miles and 37 chains, and the distance from the *depot* to Market street (the centre of business) is 59 chains, making 34 miles and 40 chains from the place of beginning on the State rail road to Market street.

The profile both of the Valley and Norristown roads, was found to be somewhat undulating.

The distance by the State rail road, from the point of deflection near Downingtown, to Vine street is 31 miles and 78 chains, and from Vine to Market is 30 chains, making 32 miles and 28 chains in all. The difference in distance in favor of the State rail road is two miles and 12 chains.

An estimate has been made of the expense of constructing a road immediately *contiguous* to the Valley rail road and the Norristown rail road, with corresponding grades and curves, which is now presented and may be taken as the estimated value of these roads respectively, when completed. A statement of the grades and curves of both roads is also presented.

No examination was specially directed by the act of assembly to be made of the Norristown road, but on account of its connection with the Valley road it was deemed proper to make a survey and estimate of a road contiguous to it.

Two thirds of the grading of the Valley road is supposed to be completed. On parts of the line the ground had not been broken, and some difficulty was experienced in ascertaining the precise grade at a few points. The profiles are believed to exhibit the designed grade very nearly.

The Norristown road having been so nearly completed that locomotives operate upon it, no difficulty was found in ascertaining the grade on that road.

Table of grades on the Valley rail-road.

No.	Length of grade.	Ascending grade.	Descending grade.	
1	21 ch'ns.	Level.		Beginning at the State rail road near Downingtown.
2	48 "	6.35 ft per m.		
3	48 "	Level.		
4	84 "	16.40		
5	42 "	21.90		
6	33 "	12.16		
7	30 "	18.64		
8	63 "	14.00		
9	45 "	25.92		
10	135 "		27.76 ft per m.	
11	57 "	Level.		
12	27 "	29.60		
13	267 "		27.90	
14	30 "		21.28	
15	30 "	Level.		
16	39 "	16.40		
17	129 "		20.46	
18	156 "	Level.		
19	36 "		13.40	
20	66 "	Level.		
21	84 "		33.34	Intersection with Reading rail road.
22	134 "		35.76	

Table of curves on the Valley rail-road.

No.	Radii North of line.	Radii South of line.	
1	6,600		Beginning at the State rail road near Downingtown.
2		14,520	
3		8,310	
4	15,180		
5		19,140	
6		7,524	
7		7,524	

ESTIMATE OF THE COST OF THE VALLEY RAIL ROAD.

Grubbing,			$1,080 00
Excavation, (mixed,)	993,336	30	298.000 80
Embankment,	974.205	20	194.841 00
Masonry—culverts,	16,330	$3 00	48,990 00
do bridges,	2,274	2 50	5,685 00
do drains,	1,195	2 00	2,390 00
Superstructures of bridges,			432 00
			$551,418 80
Cross ties,	70,488	80	56,390 40
Rails, (iron,)	3,530 tons,	70	247,100 00
Spikes,	91,747 lbs.	8	7,339 76
Turnout plates,	8,000 "	6	480 00
Splicing plates,	541,320	6	32,479 20
Laying 20 miles 4 chains,		$2,000 00	40,100 00
Bridge over Schuylkill,			41,185 00
			$976.493 16
Add 10 per cent,			97 649 31
			$1.074,142 47

Table of grades on the Norristown rail road.

No.	Length of grade.	Ascending grade.	Descending grade.	
1	64 ch'ns.		11.90 ft per m.	Beginning near Conshohocken.
2	36 "		4.22	
3	158 "	Level.		
4	56 "	16.37 ft per m.		
5	18 "	Level.		
6	6 "		25.73	
7	65 "	12.95		
8	30 "		20.84	
9	27 "	18.15		
10	19 "		13.46	
11	38 "		26.36	
12	141 "	31.74		
13	42 "	15.48		
14	30 "		14.77	
15	54 "	23.97		
16	156 "		32.28	
17	29 "		14.60	
18	58 "		28.95	
19	18 "	37.46		
20	9 "		29.33	

Table of curves on the Norristown rail road.

No.	Radii East of line.	Radii West of line.	
1	3,782 feet.		
2	2,521 "		Beginning near Conshohocken.
3		2,521 feet.	
4		2,973 "	
5		3,782 "	
6	1,891 "		
7		4,538 "	
8	1,261 "		
9	3,782 "		NOTE. The curves were measured as accurately as could be conveniently done with a common compass and chain. The radii as represented are supposed to be near the truth, but may differ in some respects from other measurements.
10	2,973 "		
11		2,835 "	
12		1,164 "	
13	1,008 "		
14		1,008 "	
15	2,973 "		
16		1,891 "	
17	1,164 "		
18	5,042 "		
19		946 "	
20		1,261 "	
21	3,782 "		
22		1,261 "	
23	1,891 "		
24	3,782 "		
25		1,135 "	
26		5,673 "	
27		1,261 "	
28	946 "		
29		1,375 "	
30		2,044 "	
31	8,909 "		
32		4,363 "	

ESTIMATE OF COST OF THE NORRISTOWN RAIL ROAD.

Grubbing,	100 chs.		600 00
Excavation, (mixed,)	369,571 yds.	30	110,871 30
Embankment,	386,949	20	77,389 80
Masonry—culverts,	7,398	$3 50	25,893 00
do drains,	1,475	2 00	2,950 00
do bridges,	7,678	4 00	30,712 00
Superstructure of bridges,			8,328 00
Protection wall,	10,839	60	6,503 40
			$263,247 50
Cross ties,	41,338	60 ct.	24,802 80
Iron rails,	1,026	$70 00	71,820 00
Chairs,	304,480	6 00	18,268 80
Bolts,	30,488	8 00	2,435 84
Spikes,	20,891	8 00	1,671 28
Timber-rail,	156,684	6 00	9,401 04
Laying 13 miles 13 chains,		$2000 00	26,325 00
			$417,972 26
Depot,			20,000 00
Estimate of work done,			$437,972 26
Estimate of cost of completing double track,			29,264 24
Estimate of cost of extending from depot to Market st.			19,103 32
			$486,339 82
Add 10 per cent.			48,633 98
			$534,973 80
Estimate of cost of Valley rail-road,			1,074,142 47
Total estimate of cost of the connection by the Valley and Norristown rail-roads,			$1,609,116 27

PHILADELPHIA AND READING RAIL ROAD.

It appeared desirable on some accounts, in case the Valley rail road should be purchased by the state, or a new road should be made by the state *contiguous* to it, with a view to avoid the plane, that the connexion should be made with the State rail road at the west end of the Belmont bridge. A survey was therefore made for a continuation of the Valley rail road, *contiguous* to the Philadelphia and Reading rail road, deflecting from the former road at the distance of 20 chains west of the Schuylkill, and descending at such rate as to meet the plane of the Philadelphia and Reading road at the distance of 102 chains south of the point of deflexion.

The line was traced parallel to the Reading road, and correspon ing with it, both in plan and profile, from the point where it is fir met, to its intersection with the State rail road

The new road is proposed to be made by widening the Readi road on the side next the hill, to such extent as to accommodate a *extra* double track.

The plane of the Reading road was found to be nearly level fro the point at which the Valley road intersects it, to within 110 chai of the State rail road, where a descending grade begins and co tinues to the junction with the State rail road at the Belmont bridg

The grading of the Reading road is far advanced towards comple tion The tunnel in progress at Flat rock, will require more time t complete than any other part of the work.

The distance from the point of deflexion on the Valley rail roa to the State rail road, at the Belmont bridge, is ten miles and 5 chains, thence to Market street is 3 miles and 47 chains, making 3 miles and 7 chains from the State rail road near Downingtown t Market street. The distance between the same points by the Stat rail road is 32 miles and 38 chains, and the difference in distance i favour of the State rail road would be one mile and 49 chains.

A statement follows of the grades and curves, also an estimate o the cost of the connexion by this route.

Table of grades on the Philadelphia and Reading rail road.

No.	Length of grade.	Ascending grade.	Descending grade.	
1	102 ch'ns.		31.73 ft. per m.	Beginning on Valley road and descending to Reading road.
2	644 "	Level.		
3	53 "		22.86 "	
4	29 "	Level.		
5	28 "	22.2 ft. per m.		Ending at west end of Belmont bridge.

Table of curves on the Philadelphia and Reading rail-road.

No.	Radii East of line.	Radii West of line.	
1		11,880	Beginning at the point of deflection from the Valley rail-road.
2	7,524		
3	1,980		
4	1,980		
5		1,881	
6	2,904		
7	6,468		
8		6,620	
9		26,400	
10		5,280	
11	2,508		NOTE. The table of curves is the result of the survey made which may differ from the design of the engineer of the road, as the rails were not laid. It is probable that in laying the superstructure several of those stated may be merged in one general curve and the number reduced.
12		1,320	
13	1,584		
14	1,980		
15		1,056	
16	1,188		
17		1,188	
18	2,970		
19	1,584		
20		1,122	
21	2.442		
22	2,772		
23		1 260	
24		3,828	
25		3,498	
26	946		

Estimate of the cost of a rail-road to deflect from the Valley rail-ad, and to run parallel with the Philadelphia and Reading rail-road the Belmont bridge.

rubbing,			$1,200 00
xcavation, (mixed,)	419.613	30	125,883 90
do (rock,) tunnel,	14.972	$4 00	59.888 00
mbankment,	62,957	20	12,591 40
asonry—culverts,	992	5 00	4,960 00
do bridges,	1,622	4 00	6,488 00
do drains,	1,011	3 00	3.033 00
uperstructure of bridges,	877	12 00	10.524 00
			$224,568 30
ross ties,	36.006	80	28,804 80
ron rails,	1.881	70 00	131.670 00
plicing plates,	282,150	6	16,929 00

Turn-out plates,	4,000	6		240 00
Spikes,	48,906	8		3,912 48
Laying 10 miles, 56 chains,		$2,000 00 pr m.		21,400 00
				$427,524 58
Add 10 per cent,				42,752 45
				$470,277 03
Estimated cost of Valley rail-road,			1,074,142 47	
Deduct bridge and 20 chains west of Schuylkill,			52,223 00	
				1,021 919 47
Total estimated cost of the connection by the Valley and Reading rail-roads,				$1,492,196 50

WEST PHILADELPHIA RAIL-ROAD.

A careful examination was made of the West Philadelphia rail-road, particularly in relation to its grades and curves. The former were found to agree almost exactly with the statement of Mr. Bailey, in his report of the 28th November, 1837, and both correspond nearly with those stated by Mr. Campbell, on his map of 1836, found in the canal commissioners office.

The road begins at a point, sixty-six chains west of the eighth mile post on the state rail road, and terminates at the west end of the Market street bridge, West Philadelphia. The distance from the place of beginning, to the Market street bridge, is seven miles and forty chains, thence to the intersection of Broad and Market streets is seventy-four chains, making eight miles and thirty-four chains in all, from the state rail road to Broad street. The distance by the state rail-road between the same points is nine miles and sixteen chains. The difference of distance therefore, in favour of the West Philadelphia rail-road, is sixty-two chains.

The grading is completed on five-sixths of the length of the road. Each portion of the road is either level or at a descending grade, from the point of intersection, at the state rail road, to the Market street bridge; the average grade being 43.3 feet per mile. The steepest grade on the road is 57.12 feet per mile for fifty-nine chains.

The following is a statement of the grades and curves, and estimate of the cost of completing the road.

Table of grades on the West Philadelphia rail road.

No.	Length of grades.	Ascending grade.	Descending grade.	
1	80 ch'ns		44.72 ft per m.	Beginning at the state rail-road.
2	96 "		44.	
3	110 "		52.	
4	22 "		48.	
5	17 "		52.	
6	19 "		52.64	
7	59 "		57.12	
8	62 "		Level.	
9	34 "		48.	
10	92 "		51.92	
11	18 "		Level.	Ending at west end of Market St. bridge at level of present graded road.

Table of curves on the West Philadelphia rail-road.

No.	Radii North of line.	Radii South of line.	
1	3,696		Beginning near the 9th mile post on the state rail-road.
2		2,574	
3	5,016		
4		7,656	
5		7,656	
6		8,052	
7	2,244		
8		1,254	Curve meeting Market st. bridge.

Estimate of the cost of the West Philadelphia Rail-road.

Excavation (mixed)	69,440	30	$20,832 00
Embankment,	153,026	20	30,605 20
Masonry—culverts,	1,568	$5 00	7,840 00
Superstructure—bridges,			1,776 00
Laying 7 miles 25 chains,		2,000 00	14,625 00
			$75,678 20
Cross ties,	25,740	80	20,592 00
Iron rails,	1,287	$70 00	90,090 00
Splicing plates,	190,125	6	11,407 50
Turnout plates,	3,000	6	180 00
Spikes,	33,462	8	2,676 96
			$200,624 66

Estimate of cost of road from West Philadelphia to Broad street,	75,650 16
Reported cost of work done,	190,000 00
Depot,	20,000 00
	$486.274 82
Add 10 per cent.	48.627 48
	$534,962 30

The foregoing estimate contains an item of $75,650 16 for continuing the rail-road from West Philadelphia to Broad street, crossing at Market street bridge. If the road should enter the city at Market street, or in that vicinity, it might be expected that a considerable portion of the expense would be borne by the city corporation.—Nevertheless it is deemed proper to include it in the estimate of the cost of the road. The items are as follows:

Excavation,	3,000	30	$900 00
Embankment,	3,000	30	900 00
Stone work,	2,138	$12 00	25 656 00
Long'l timbers 10 by 12 inches,	10,200	10	1,020 00
Cross beams 8 by 10 do	18,508	8	1,480 64
Plank B. measure,	51,000	15 00	765 00
Superstructure of bridge over Bridge water street, 70 feet		10 00	700 00
Superstructure at Ashton street 70 ft.		10 00	700 00
do over Schuylkill, 550 ft.		35 00	19.250 00
Iron rails,	131	70 00	9,170 00
Splicing plates,	13.860	6	831 60
Turn out plates,	4,000	6	240 00
Spikes,	5,089	8	407 12
Stone blocks, 28,512 cubic feet,		40	11 404 80
Laying 1 mile 9 chains,		2,000 00	2,225 00
			$75.650 16

CHESTER AND DELAWARE, AND PHILADELPHIA AND WILMINGTON RAIL-ROAD.

The section of the act of Assembly, before quoted, contemplates an examination of the Chester and Delaware rail road, and the Philadelphia and Wilmington rail-road, with the view, as would appear, of determining the expediency of avoiding the Schuylkill plane by means of these two roads in connexion with each other.

On inquiry it appeared that the former road had not been constructed, and therefore could not be examined, and for the same reason a survey of the latter was deemed unnecessary. The line run by Mr. Baily from the State rail-road at the crossing of the

East Brandywine, to its intersection with the Philadelphia and Wilmington rail-road near Old Chester and the line of the latter road, thence to its termination at the intersection of Broad and Prime streets, have been laid down on the map herewith presented. This appeared proper, as the former is understood to have been traced near the contemplated route of the Chester and Delaware rail-road.

Through the politeness of Samuel H. Kneass, Esq. engineer of the Philadelphia and Wilmington rail-road, a correct plot has been received of that portion of this road between the city and Old Chester, which has enabled me to exhibit a view of the line *in plan.*

For the details of the estimate of cost of a rail-road from East Brandywine to Old Chester, I beg leave to refer the board to the report of John P. Baily, Esq. of the 8th November, 1837. It amounts to the sum of $1,479,599 00. Distance 22 miles and 77 chains. From the point of intersection with the Philadelphia and Wilmington road to Prime street is eleven miles and 17 chains, thence along Broad street to Market is 82 chains; making 35 miles and 16 chains from the State rail-road at East Brandywine to Market street. The distance by the State rail-road between the same points is 33 miles and 56 chains. The difference, therefore, in favor of the State rail-road is one mile and 40 chains.

The Philadelphia and Wilmington rail-road passes the Schuylkill immediately below Gray's ferry, by means of a bridge, with a *draw* to admit mast vessels to pass and repass.

As the question of avoiding the Schuylkill plane is one of much importance to the public, the undersigned was induced to examine several *new routes* which appeared to possess advantages.

Indian creek route.

This route begins near White Hall, and deflects from the State rail-road 27 chains west of the 11th mile post, where the Lancaster turnpike crosses the rail-road. The grades of the State rail-road ascend each way from this point.

The plane of the new route is level for 24 chains, *thence it descends by grades which in no instance have a greater declivity than* 41.60 *feet to the mile to within* 22 *chains of Market street, in West Philadelphia.* From this point the plane of the road may preserve a level until it meets the east side of the Schuylkill. The average grade from White Hall to the Schuylkill is 33 feet per mile.

If a road should be made upon this route, it is presumed that it will either cross the Schuylkill at Market street, or at one of the streets between Market street and Fairmount; and if so, the plane of the road, after leaving the bridge, may descend at a grade not exceeding 42.4 feet to the mile, to the point where it will meet the plane of the street. The grades of the street will be ascending from this point to Broad street, but no where at a higher grade than 45 feet per mile.

The line of the route is traced along the sloping grounds on the northeast side of Cobbs' creek, crossing the north and west forks of

Indian creek, near Haddington, thence by Blockley, crossing the West Chester road and curving into the range of Spruce street, which range is pursued (parallel with the West Chester road) to near the Almshouse. Here a reversed curve commences which terminates by one route at the west end of the Market street bridge, and by another at the west end of a bridge proposed to be built at Race street.

The ground about the forks of Indian creek is irregular. Deep cuts will be encountered here, and large embankments will be necessary to pass the valleys of the streams. Culverts of sufficient capacity have been estimated for passing the streams at these points. From Haddington to the West Chester road, the ground descends very uniformly, but it is below the grade, so that an embankment will be required for a distance of one and a quarter miles. Portions of the ground between Blockley and West Philadelphia are very favorable. A large embankment will be necessary to pass the valley of Mill creek, and a deep cut will be required opposite Hamilton village.—The greatest depth of cutting will be 34.5 feet. The ground from Hamilton village to the Schnylkill may be termed favorable.

No valuable buildings need be interfered with on this route, nor will excessive damage be done to any of the lands through which it lies.

The distance from the point of deflection, near White Hall, to the intersection of Broad and Market streets is eleven miles and forty chains. The distance by the present road, between the same points, is eleven miles and fifty-seven chains. The difference in favor of the Indian creek route is seventeen chains.

A statement follows of the grades and curves on the Indian creek route, also an estimate of the cost of a road upon this route.

Table of grades on the Indian creek route.

No.	Length of grade.	Ascending grade.	Descending grade.	
1	24 ch'ns.	Level.		Beginning near White Hall.
2	309 "		40.00 ft per m.	
3	72 "		28.32 do	
4	84 "		40.00 do	
5	111 "		41.60 do	
6	33 "		20.00 do	
7	99 "		21.60 do	
8	77 "		34.40 do	
9	46 "	Level.		At 37 chs. west end of bridge.
10	18 "		42.40 do	
11	47 "	30.00 ft per m.		

Table of curves on the Indian creek route.

No.	Raddi north of line.	Radii south of line.	
1	946		Beginning near White Hall.
2	2,112		
3	3,498		
4		2,740	NOTE.—The curve No. 1, is one of the original curves of the Columbia and Philadelphia rail road, at the point of deflection. The plane of the new road is proposed to be level here.
5		2,013	
6	2,000		
7		2,000	
8		2,000	
9	3,600		
10	2,706		
11	1,518	1,518	Curve meeting Market st. bridge.
12		1,122	Curve meeting Race st. bridge.
13		1,122	East end of Race st. bridge.

ESTIMATE OF THE COST OF A RAIL-ROAD ON THE ROUTE BY INDIAN CREEK.

Grubbing.			$846	00
Excavation (mixed)	630,184	30	189,055	20
Embankment,	708,733	20	141,746	60
Masonry—culvert,	6,498	$5 00	32,490	00
do bridges,	5,016	5	25,080	00
do drains,	518	3	1,554	00
			$390,771	80
Cross ties,	36,564	80	29,251	20
Iron rails,	1,828	$70 00	127,960	00
Splicing plates,	274,200	6	16,452	00
Turnout plates,	4,000	6	240	00
Spikes,	47,531	8	3,802	48
Laying rails, 10 miles, 3 chains,		$2,000	20,775	00
			$589,252	48
Estimate of cost of road from West Philadelphia to Broad street,			75,650	16
			664,902	64
Depot,			20,000	00
			684,902	64
Add 10 per cent.			68,490	26
			$753,392	90

NAYLOR'S RUN ROUTE.

The line of the Naylors run route deflects from the state rail-road, at the same point with the last described route, and pursues the same course and level for twenty-four chains. From the termination of this distance, the line is traced on the south west side of Cobbs creek, crossing the dividing ground between that stream and Naylor's run, near Lyons' tavern, and pursuing the north eastern slope of the valley of Naylors run it crosses Cobbs creek about twenty chains above Sellers' Iron works, in the direction of Spruce street, and falling into the line of the Indian creek route at Blockley, the two routes are coincident thence to the city.

The line is entirely straight for the distance of three and a half miles west of the Almshouse. There are no grades on this route higher than forty feet to the mile, and each portion of the road west of the Schuylkill is either level or descending towards the city. The average grade from White Hall to the Schuylkill would be 32.1 feet per mile.

On a considerable portion of this route the ground is favorable. In passing the high ground between Cobbs creek and Naylors run, a cut of 100 chains in length is necessary. The deepest cutting here would be 35.5 feet. No very formidable obstacles present themselves between this point and Cobb's creek. That stream is passed at the height of 70 feet above the bottom of the valley. It is proposed to erect a bridge over the valley 600 feet in length. The table land on the eastern side of the valley is twenty feet below the grade, but at Blockley 60 chains further east the surface nearly coincides with the grade. That part of the line between Blockley and the city being common, both to the Indian creek and Naylors run route, has already been described.

The distance from the point of deflection, to the intersection of Broad and Market streets, is eleven miles and sixty chains, and by the present road, eleven miles and fifty-seven chains. The difference in favour of the present road is three chains.

Table of grades on the Naylors Run route.

No.	Length of grade.	Ascending grade.	Descending grade.	
1	24 ch'ns	Level.		Beginning near White Hall.
2	108 "		36.8 ft per m.	
3	60 "		32.56	
4	439 "		40.	
5	22 "		20.	
6	99 "		21.6	
7	77 "		34.4	
8	46 "	Level.		At 37 chs. West end of bridge.
9	18 "		42.4	
10	47 "	30.00		

Table of curves on the Naylors Run route.

No.	Radii North of line.	Radii South of line.	
1	946 feet.		Beginning near White Hall.
2		8.382 ft.	
3	7,392		NOTE.—Curve No. 1, is one of the original curves of the Columbia and Phila. rail-road at the point of deflection. The plane of the new road is proposed to be level here.
4	7,392		
5	5,280		
6	13,400		
7	2,706		
8	1,518		
9		1,518	Curve meeting Market st.bridge.
		1,122	Curve meeting Race do.
10		1,122	East end of Race street bridge.

Estimate of the cost of a rail-road on the route by Naylor's run.

Grubbing,	121 ch's.	$6 00	$726 00
Excavation (mixed,)	572,761 yds.	32	183,283 52
Embankment,	664,470	20	132,894 00
Masonry—culverts,	3.925	5 00	19,625 00
do roads,	2,806	5 00	14,030 00
do drains,	1,015	3 00	3,045 00
do bridge (Cobb's cr'k)	7,490	5 00	37,450 00
Superstructure do do			9,000 00
			$400,053 52
Cross ties,	37,444	80	29,955 20
Iron rails,	1,872	$70 00	131,040 00
Splicing plates,	280,800	6	16,848 00
Turnout plates,	4,000	6	240 00
Spikes,	48,925	8	3,914 00
Laying 10 miles 51 chains,		2,000 00	21,275 00
			$603,325 72
Estimate of cost of road from West Philadelphia to Broad street,			75,650 16
			$678,975 88
Depot,			20,000 00
			$698,975 88
Add 10 per cent.			69,897 58
			$768,873 46

ROUTE FRON NEAR WHITE HALL BY THE WAY OF HESTONVILLE AND THE UPPER OR FAIRMOUNT BRIDGE, TO THE CITY.

This route occupies the same ground with the Indian creek route, as far as station 163, east of the Indian creek, near Haddington.—From this point the line bears in the direction of Hestonville, and connects with the line of the West Philadelphia rail-road near that place, and runs contiguous to it as far east as Elliot's tavern, where the Mantua road branches off from the Lancaster turnpike. From this point the line is traced directly to the Fairmount bridge, crossing the Schuylkill at this point and connecting with the State rail-road, near the old collector's office.

The ground has already been described as far as to Haddington. From Haddington to the Schuylkill it is tolerably favorable for such grades as follow in the table, except on the portion of the route in the vicinity of Mantua village, where a deep cut will be necessary to descend to the level, suitable for crossing the river and for entering the city. The river would be crossed at an elevation of 46 feet above high tide. The bridge should be calculated both for common road carriages and as a rail-road bridge, the common road way to be placed at the usual height, and the rail-road track on top of the bridge.

The highest grade on the route, as appears by the table, is 57 feet to the mile for a distance of 18 chains. Another grade occurs of 46 feet to the mile for 69 chains. Between those portions of the road there is a level of 63 chains, so that the higher grades might be reduced slightly, by incurring some additional expense. The average grade from White Hall to the Schuylkill would be 36 feet per mile.

There would be some damage done to private property, in approaching the Schuylkill, at Mantua village. The damages on the eastern side of the Schuylkill, it is thought, would not be very heavy.

The distance by this route, from the place of beginning on the State rail-road to the intersection of Broad and Market streets, is 11 miles, and 11 chains. The distance between the same points by the present road is 11 miles and 57 chains, and the difference in favor of the route by Hestonville and the Fairmount bridge, 46 chains.

Table of grades on the White Hall, Hestonville, and Fairmount bridge route.

No.	Length of grade.	Ascending grade.	Descending grade.	
1	24 ch'ns.	Level.		Beginning near White Hall.
2	309 "		40 ft per m.	
3	72 "		28.32 do	
4	84 "		40. do	
6	81 "		39.3 do	
7	18 "		57.12 do	
8	63 "	Level.		
9	69 "		46.00 do	
10	41 "			Level across bridge, then descending to present road near the collector's office.

Table of curves on the White Hall, Hestonville and Fairmount bridge route.

No.	Radii of N. line.	Radii of South line.	
1	946 ft.		Beginning near White Hall.
2	2,112		
4	3,498		NOTE.—Curve No. 1, is one of the original curves of the Col. and Phil'a rail-road at the point of deflection.—The plane of the new road is proposed to be level here.
5		2,740 feet.	
6		2,013	
7	2,000		
8		2,000	
9		2,000	
10	1,848		
11		2,508	
12		7,564	
13		7,564	
14	1,980		
15	1,782		West end Fairmount Bridge.
16		400	East do do do
17	900		
18		900	Near collector's office.
19	900		
20		294	

The following is an estimate of the cost of a rail-road, beginning near White Hall, thence crossing the branches of Indian creek, and passing near Hestonville and the Fairmount bridge, & terminating near the old collector's office on the Columbia and Philadelphia rail-road.

Grubbing,			$606 00
Excavation, (mixed,)	626,323	30	187,896 90
Embankment,	482,906	20	96,581 20
Masonry culverts,	8,827	$5 00	44 135 00
do. Piers E. of Schuylkill,	2,622	12 00	31,464 00
do. Drains,	918	3 00	2,754 00
Longl. timbers 10 by 12 inches,	9,600	10	960 00
Cross beams, 8 by 10, "	12,468	8	997 44
Plank, board measure,	48,000	15 00	720 00
Superstructure, bridge at Fairmount street,	70	10 00	700 00
Superstructure, bridge at Williams street,	70	10 00	700 00
Bridge at Schuylkill,			50,000 00
			417,514 54
Cross ties,	33,560	80	26,848 00
Iron rails,	1,693	$70 00	118,510 00
Splicing plates,	261,260	6	15,681 60
Turn out plates,	4,000	6	240 00
Spikes,	45,302	8	3,624 16
Laying 9 miles 72 chains,		2,000 00	19,800 00
			602,218 30
Depot,			20,000 00
			622,218 30
Add 10 per cent,			62,221 83
			$684,440 13

In addition to the routes described, lines were run upon several other routes for the purpose of gaining a full knowledge of the country, and its capabilities.

GULF CREEK ROUTE.

This route begins on the state rail road, at the distance of thirty chains west of the 16th mile post, and pursues the south western slope of the valley of Gulf creek, to near the upper Gulf mill, thence passing across the summit, between the Gulf creek and the Schuylkill, the line is traced along the sloping ground near the Schuylkill, until it meets the plane of the Philadelphia and Reading rail road, at the west end of the Flat Rock tunnel on said road, where it falls into the line run parallel with the Reading road already described. In connection with this line, it would form a junction with the state rail road at the western end of the Belmont bridge.

The distance by this route from the place of beginning on the state rail road, to Market street would be 18 miles and 62 chains. The distance by the present road, between the same points is 16 miles and 59 chains, and the difference in favor of the present road is two miles and three chains.

The general features of the country through which this route was traced, were found to be very irregular, and such as not to admit of the adaptation of a favorable line, either in plan or profile.

The average grade from the place of beginning to the point of connection with the plane of the Reading road was 37 feet per mile.

It is not supposed that any modification of this line would result in much improvement, taking into view graduation, curvature and expense of construction.

The aggregate cost of a road upon this route, connecting with the state rail road at the west end of the Belmont bridge, is estimated at $1,136,685 57.

The estimates of cost of roads, upon the several routes described, pre-supposes that the excavation for the road way, will be made 24 feet wide at the plane of the road, and the embankment 22 feet wide.—The culverts and bridges to be all arched with stone, except the bridges over Cobb's creek and over the Schuylkill. The superstructure of the road to consist of a double track with locust cross sills, spaced at an average distance of three feet apart from centre to centre, and iron rail with cast iron splicing plates secured with heavy iron spikes, the rail to weigh fifty pounds to the yard.

There are a few wooden superstructures of bridges on the Valley, Norristown, Reading and West Philadelphia rail roads, which should be excepted in that part of the last paragraph which relates to the bridges estimated.

No plank has been estimated to bed the cross ties upon, the advantage of using them not being deemed commensurate with the expense.

MILL CREEK ROUTE.

A route for avoiding the plane, was examined along the valley of Mill creek, a stream which takes its rise near to the 11th mile post on the state rail road, and enters the Schuylkill about one and a half miles above Manayunk.

The line begins at the same point with the Indian creek route, (27 chains west of the 11th mile post,) and descends at an average grade of 51 feet to the mile, to the plane of the Philadelphia and Reading rail road, which it meets at the north end of the Flat Rock tunnel.

The distance by this route from the place of beginning to Market street, would be fifteen miles. The distance between the same points by the present road is 11 miles and 57 chains, shewing a difference in favor of the present road of 3 miles and 23 chains.

Besides the increase of distance, the shape of the ground was found to be illy adapted to the construction of a road, and the expense would be comparatively great, and the curvature objectionable. It was deemed unnecessary to make an estimate of its cost.

ROUTE CROSSING THE SCHUYLKILL INCLINED PLANE.

A route was also examined, beginning on the state rail-road, near the General Wayne tavern (6th mile post,) and pursuing the ground sloping towards the Schuylkill, on the north of the state rail-road until it meets the road fifteen chains west of the foot of the inclined plane. After crossing the plane it passes down the western side of the Schuylkill to the Fairmount bridge, when it meets the line passing Hestonville.

The distance by this route, from the 6th mile post to Market street, is eight miles and forty-two chains. The distance by the present road is six miles and thirty chains. The difference in favor of the present road is two miles and twelve chains.

The average grade from the place of beginning to the Schuylkill is thirty-seven feet per mile.

The ground on this route was found to be quite unfavourable.—The road would be very expensive, and the route would be objectionable on account of the large proportion of curved road necessary. No estimate has been made of the cost of a road upon this route.

A line was run from station 163, on the Indian creek route, to the west end of the Belmont bridge, crossing the West Philadelphia rail road near Hestonville, to determine the expediency of connecting with the state rail road, at the west end of said bridge.

The distance between those points was found to be two miles and seventeen chains, and the average grade 49.4 feet per mile, terminating at a level fifteen feet above the plane of the road at the bridge, with a view of passing the rail-road over the bridge at that height above the present road, and grading down to meet the present road to the east of the bridge. The distance by this route from the point of deflection, near White Hall, to Market street, would be eleven miles and seventy-three chains. The distance by the present road, between the same point is eleven miles and fifty-seven chains, and the difference in favor of the present road sixteen chains.

A line was also traced from station 96, on the Naylors run route, to intersect the Philadelphia and Wilmington rail-road, at the west end of the bridge at Gray's ferry. The ground was found unsuited to such grades as are deemed admissable, and is otherwise unfavorable.

The distance, by this route from the state rail-road near White Hall, to Gray's ferry bridge is nine miles and seventy-two chains, thence to the intersection of Broad and Market streets, is two miles and seventy-one chains, making twelve miles and sixty-three chains in all, from the state rail road to Market street. The distance between the same points, by the present road, is eleven miles and fifty seven chains, and the difference in favor of the present road one mile and six chains.

To arrive at correct conclusions in regard to the main question involved in the section of the Act of Assembly before referred to, the Columbia and Philadelphia rail-road should be viewed, but as a single link in a long chain of improvement of a like kind, designed to stretch from the city of Philadelphia, to the lakes, and to Pittsburg, and ultimately to the Mississippi.

In the investigation of the question, another of lesser magnitude presents itself, which must be first satisfactorily answered in order to determine the greater, viz: Is it probable that the "Gap" grades will ever be reduced?

The principal rail-roads connected with the Columbia and Philadelphia rail-road, as branches or extensions, are the Lancaster and Harrisburg, and Cumberland valley rail-roads, and the Wrightsville, York and Gettysburg rail-roads.

On the Lancaster and Harrisburg rail-road, there are grades as high as forty-two feet per mile, of 1100 and 1300 feet in length respectively, in connexion with curves of 1042 to 1146 feet radius.

On the Cumberland valley rail road, there is one grade of forty-five feet per mile on a straight line, one and a quarter miles in length; one of forty-two feet per mile, on a line nearly straight for two miles, and one of thirty-seven feet per mile, on a straight line three miles long.

On the Wrightsville and York rail-road, the highest grades do not exceed 31.68 feet per mile, in connexion with curves of 8000 feet radius.

On the Gettysburg rail-road, the maximum grades are fifty feet per mile, with radii of 1,000 feet in length, as appears by the report of the engineer of the road.

It has been discovered and well tested, that locomotives can operate advantageously on grades of forty-five feet per mile, with curves having radii of 1,981 feet.

An experiment recently made on the "Gap" grades, by A. Mehaffey, Esq. superintendent of motive power on the Columbia and Philadelphia rail-road, seems to show that the momentum acquired on the lower or flatter grades in approaching the higher grades of a rail-road is not much felt in overcoming the higher, unless they are very limited in extent; in other words its useful effect is but slight.

As there will be strong inducements to adopt the highest admissable grades on our rail-roads leading into the interior, and passing over mountainous regions for the purpose of saving expense in construction, it seems probable that grades of forty-five feet per mile will be but ordinary grades on the great lines of rail-road, in continuation of the Columbia and Philadelphia rail-road. There is therefore, in the opinon of the undersigned, no probability that the "Gap" grades will be reduced, because the capacity of the whole chain of rail-road would not thereby be augmented.

Taking the "Gap" grades then as the *maximum* grades admissable on the road to avoid the Schuylkill inclined plane, the selection should, in the opinion of the undersigned be made from the following routes:

1. The Valley rail road in connection with the Norristown rail road or by roads contiguous to them.
2. The Valley rail road in connection with the Philadelphia and Reading rail road, or by roads contiguous to them.
3. The Indian creek route.
4. The Naylor's run route.

To determine the relative resistance to motive power on the grades of those routes, the degree of gradation must be considered in connexion with the degree of curvature on the portions of the road where the greatest resistance is anticipated.

On an inspection of the grades of those different routes, it appears that the steepest grades on the Valley rail road, ascending westward, is 35.76 feet per mile, for 134 chains in connexion with a grade of 33.34 feet per mile, for 84 chains making an average grade of 34.83 feet per mile for two miles and 58 chains. The curves of shortest radii on these grades are 7,524 feet respectively. The steepest grade ascending eastward, is at the rate of 29.6 feet per mile for 27 chains, with a curve of feet radius.

On the Norristown rail road the steepest grade ascending westward, for any considerable extent is at the rate of 32.28 feet per mile, for 156 chains with a curve of 946 feet radius. The steepest grade ascending eastward is at the rate of 31.74 feet per mile for 141 chains, with a curve of 1,135 feet radius.

On the Reading rail road the steepest grade ascending westward, is at the rate of 22.86 feet per mile for 53 chains, in connexion with a curve of 1,513 feet radius. The new road if made contiguous to the Reading road, may be free from grades ascending westward.

On the Indian creek route, the steepest grade ascending westward, is at the rate of 41.6 feet per mile for one mile and 31 chains in connexion with a grade of 40 feet per mile for one mile and four chains. The shortest radii of curves on these portions of the route, are 2,000 feet respectively. There are no grades on this route west of the Schuylkill which ascend eastward. The steepest grades on the state rail road between White Hall and Downingtown, ascending in that direction, are at the rate of 28.2 feet per mile in connexion with curves of 631 feet radius. This part of the state rail road may be greatly improved at a moderate expense, compared with the advantages which would result from it.

The steepest grades on the Naylor's run route, ascending westward, rise at the rate of 40 feet per mile for 5 miles and 39 chains, with curves in connexion of 5,280 feet radius. There are no grades on this route ascending eastward between the Schuylkill and the point at which the state rail road is intersected. The steepest grades on the state rail road between White Hall and Downingtown are as before stated.

The grades and curves of the Valley and Norristown roads, particularly those of the former, cannot but be pronounced favorable. The termination, however, being at the intersection of Ninth and Green streets, is considered unfavorable for the western business; moreover, if those roads should be adopted by the state as a means of avoiding the plane, it would have the effect of entirely changing the place of of storing and forwarding, thereby occasioning great inconvenience and loss to those who have made large investments in houses and fixtures for that business; the increase of distance is also an objection.

In comparing the grades, curves, distance and estimate of cost of the Indian creek and Naylor's run routes, the latter appears to have the advantage. The termination at the city, whether at the intersection of Market and Broad streets, or at the intersection of Race and Broad, would be so near to the present forwarding houses as to produce no derangement in the business of transportation even of a temporary nature.

Much may be said in favor of the adoption of the Valley road, in connexion with a road upon the same plane with the Reading road for avoiding the Schuylkill plane. The entrance into the city remaining as at present, crossing the river by the bridge already built at Belmont, and the grades being easy are arguments of some weight in favor of the route. On the other hand the increase of distance by this route, (being one mile and forty-nine chains,) is an objection which ought to have its due weight. The grades and curves upon this route are more favorable, than upon the Naylor's run route. But the grades upon the latter route are sufficiently easy to admit of the advantageous use of motive power, and the capacity of the road, as a whole, would not be increased by the adoption of the former, so long as the gap grades are unchanged. It therefore becomes wholly a question of expense. Both the first cost of the road and the comparative cost of transportation between Philadelphia and Downingtown have a bearing on the question. The difference in the estimated cost of the roads by the two routes is $723,323 04 in favor of the route by Naylor's run; as respects cost of transportation a comparison may be made as follows:

The highest grade on the Valley and Reading rail-roads, *ascending westward*, rise at the rate of 35.76 feet per mile. The highest grades on the Naylor's run route, *ascending westward*, rise at the rate of 40 feet to the mile.

According to a table furnished by Mr. William Norris, manufacturer of locomotives, the load with which an engine of medium power is capable of surmounting grades of 40 feet per mile, at 15 miles per hour, is 104 tons, and by the same authority the same engine can overcome a grade of 35.76 feet per mile, at 15 miles per hour, with 113 tons.

It would then require eleven engines of this power to transport 1,140 tons over the 40 feet grades, at the rate of fifteen miles an hour, and ten engines would be sufficient to transport the same quantity at the same rate per hour, over grades of 35.76 feet per mile, so that the cost of one engine, its appendages and attendance would be saved on the 35.76 feet grades for every 1,140 tons transported.

Assume the whole length of the Columbia and Philadelphia railroad (83 miles,) as a day's travel for an engine and train; then the saving of cost of transportation on the road limited by the 35.76 feet grades, over those limited by 40 feet grades, may be stated as follows:

One engineer one day,	$2 50
One fireman do do	1 25
Fuel for the trip,	9 00
Oil for engine and tender,	50
Wear and tear 2 cents per mile,	1 66
Interest on cost of engine and tender $8,000 00, one day,	1 60
Extra cost on 1,140 tons for 83 miles=1½ cts. per ton,	$16 51[*]

The distance from Philadelphia to Downington being 33 miles, the proportion of expense applicable to this distance would be $6 56, or rather more than half a cent per ton.

If the reciprocal transportation between Philadelphia and Downington, destined to be confined to that portion of the road, should amount to 1,000,000 tons annually, the difference of cost of carrying it would be $5,000 00, which would be the interest of $100,000 00 at 5 per cent. By this process of calculation this sum would be the utmost cost that would be warrantable to reduce the grades, ascending from the city westward, from 40 feet to 35.76 feet per mile.

It follows, therefore, that the state can better afford to construct a new road on the Naylor's run route, and reduce the tolls slightly, if necessary, to compete with parallel roads, than to pay the extra cost of a road by the way of the Valley and Reading roads.

It appears by the reports of Frederick Graff, Esq., and of Samuel Hains, and David McClure, Esq., (dated 19th December, 1831, respectively,) who were employed by the city councils to take soundings along the Schuylkill, from the Fairmount water works to Gray's ferry, that the bottom of the river at Race street is firmer than at most other points between Fairmount and Market street. Messrs. Hains and McClure say that the bottom of the river at this place is "one general ledge of rocks nearly half way across." For this reason and that no obstacle may be presented to the erection of a "free bridge" at Arch street, the Indian creek and Naylor's run lines are continued up to Race street, and an estimate has been made of the cost of a bridge at that point, as well as for altering the Market street bridge.

Through the kindness of Samuel Hains, Esq., surveyor of the city proper, I am enabled to submit the following statement of soundings at Race street. The measurements across the stream begin at the Race street wharf on the east side of the river, and are made at right angles to the stream. The first column shews the distance at which sounding was taken from the shore or wharf. The second column the corresponding depth of alluvion, the nature of which is given, and the third the depth to hard bottom, from the surface of the water, the character of which is also stated.

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[*] Note.—The items in this statement constitute but a small proportion of the *whole* cost of transporting the load of one engine, but are believed to be all that are applicable to the *difference* in the cost of transportation on the grades referred to.

33 feet.	11 feet--clay.	15 feet—mud,
66 "	12 " rock,	12 " rock,
99 "	12 " do	12 " do
132 "	12 " do	12 " do
165 "	11 " do	11 " do
198 "	9 " do	9 " do
231 "	10 " sand,	12 " gravel,
264 "	11 " do	13 " do
297 "	10 " do	15 " do
330 "	9 " do	15 " do
363 "	8 " do	15 " do
396 "	5 " do	15 " do
429 "	3 " do	15 " do
450 "	to low water.	

The floor of the Market street bridge, at the eastern end, is 23.58 feet above high tide. Mr. Graff states in his report, that during the freshet of 1812, the ice and water rose ten feet and two inches above high tide, and consequently to within 13.42 feet of the floor of the bridge.

In case the rail-road should pass over Market street bridge, it is proposed to alter the bridge so as to depress the road to a level, 5.58 feet lower than the floor now is, at the eastern end. It would then be eighteen feet above high tide, and 7.84 feet above the freshet of 1812. It would also be four feet higher than the ground at the intersection of Ashton and Market streets. The rail-road would approach the bridge at a level thirty-three feet above high tide, by a curve which would terminate at the western end of the bridge, and such that the centre line of the bridge would be tangential to it. The rail-road would preserve a level to the eastern end of the bridge, at the height of fifteen feet above the road-way. Here a grade would commence which would descend at the rate of 42.4 feet per mile, for 949 feet, meeting the plane of Market street at Schuylkill Second street. From this point to Broad street (47.5 chs.) the grade will ascend, (coinciding with the plane of Market street) at the rate of thirty feet per mile.

The rail-road from the west side of Bridgewater street to the western end of the bridge, and from the eastern end of the bridge to Front street, would be supported by pillars of cut stone. It would pass over Bridgewater and Ashton streets, by means of bridges, at such height as to permit carriages to pass under them with ease. At Front street the plane of the road would be 9.78 feet above the street, and would be sufficiently high for persons on foot or on horse back to pass under it conveniently, but carriages would pass around by Ashton and Schuylkill Second streetst. The pillars would form three rows, which would be twenty feet apart. from centre to centre. This arrangement would be continued to Ashton street. From Ashton street to Front street there would also be three rows, but contracted to the distance of ten feet apart, from centre to centre. The rail road would take twenty two feet in breadth of the street, east of Ashton street, so that thirty-nine feet would be left clear of the buildings on each side of the street.

As the expense of the alteration, on the bridge, would fall but little below that of a new superstructure, the estimate is made for the latter, and 550 feet between the abutments.

The length of the bridge at Race street should be at least 550 feet between the abutments. The superstructure would be designed, both for a common road bridge and a rail-rod bridge, their respective heights to correspond with those recommended for the bridge at Market street. The bridge should be placed at right angles to the stream, and would be connected with Race street, by a curve of 1122 feet radius. The grade descending from the western end of the bridge, would meet the plane of Race street, in the same manner as at Market street, and the work would be executed upon the same plan, the approaches to be in every respect similar. Race street should be widened to 100 feet from theeastern end of the bridge to Schuylkill Second street; however this would not be absolutely necessary.

If thought necessary to keep out of reach of freshets, the floor of the bridge and of course the plane of the rail road might be placed four feet higher than that just proposed; it would only involve some additional expense.

The cost of the bridge at Race street, built in a substantial manner, is estimated at $80,000 and in case this place of crossing should be adopted, the difference between this sum and the estimated cost of altering the bridge at Market street, viz: $60,750 should be added to the aggregate estimate of the route.

Upon the plan proposed for those bridges, they would be roofed at the level of the rail road track, the roofing timbers to be previously shaped for the purpose of receiving a course of plank to be covered with plates of zinc, having a slight fall from the centre to the eaves. The bridge over Cobb's creek is proposed to be covered in the same manner.

As the intersection of Broad and Market streets is likely to be the centre of business connected with storing and forwarding all of the different routes of rail roads are calculated as terminating at that point.

In the estimates of cost of the several routes submitted, no deduction is made on account of the materials of the old road, which may be transferred from the present to a new road. They are estimated at $10,000 per mile, on the supposition that all the materials necessary to complete the northern track have been provided by the state, and it is estimated that each mile of materials would reduce the cos of the new road that amount. When the distance to be transferred is known, the calculation to show the reduction on the cost of each mile of the route, can easily be made. The distance applicable to each case, will be found by inspecting the several estimates.

For the reasons already set forth, it is the opinion of the undersigned that the inclined plane should be avoided, by adopting a route which would deflect from the State rail-road at a point about twenty-seven chains west of the eleventh mile post, near White Hall, and thence passing to the south of the State rail-road, it would cross the Schuylkill either at the Market street bridge, or at some point between it and the Fairmount bridge, and that a line should be traced between the line of deflexion at the State rail road and the Schuylkill, such, that the resistance to locomotives and trains, whether moving eastward or westward, would, on no part of it, be greater than the resistance which is met with in ascending the grades at the Gap of the Mine ridge; and that there may be nothing to prevent the most judicious arrangement of the line, both in plan and profile, it is recommended that every latitude be allowed to the engineer, between those points, in determining the details of the location.

It would be most conducive to the public interest, in the opinion of the undersigned, that the road should enter the city at the Market street bridge. This, however, may meet with opposition from the bridge company, and possibly from the West Philadelphia canal company, unless a *draw* should be made at the canal. If a *draw* should be necessary, it would constitute a formidable obstacle to the connexion at Market street bridge, and it then might be necessary to connect at Race street or elsewhere, in the same vicinity.

By deflecting from the State rail-road at some point east of the Paoli, the West Chester rail-road, an important auxiliary to the State rail-road, will be accommodated, as formerly, and if the state should be *obliged* to divide the business between Downingtown and Philadelphia, with the Valley rail-road company, the *public* would probably be the better served.

Should the route recommended be adopted, the state will still have an interest in keeping up that part of the present road between the Belmont bridge and the city, to accommodate the business of the branch of the Reading rail-road, which now connects at the west end of the bridge; or she may dispose of this part of the road to the Reading rail-road company, provided it can be sold for its value. This may be the subject of negotiation before any plan for avoiding the plane is finally adopted.

Respectfully submitted.

JAMES D. HARRIS,
Engineer.

February 2d, 1839.